REMARKS

Reconsideration of this application, as amended, is respectfully requested.

THE CLAIMS

Claim 1 has been amended to recite that the voltage applied to the ejection electrode by the voltage applying unit is less than a Rayleigh marginal voltage so that the ejected droplet is not scattered, as supported by, for example, Fig. 9 and the disclosure in the specification at page 34, lines 3-15. Claim 1 has also been amended to make a minor grammatical improvement at lines 14-15.

Claim 16 has been amended to recite that an inner diameter of the nozzle is more than 0.2 μm and not more than 20 μm, as supported by the disclosure in the specification at, for example, page 49, line 25 to page 50, line 4, and page 50, lines 8 and 9. See also, for example, page 34, line 10 to page 35, line 7.

And claims 17 and 18 have been amended to make grammatical changes to better accord with claim 16.

No new matter has been added, and it is respectfully requested that the amendments be approved and entered.

THE PRIOR ART REJECTION

Claim 1 was rejected under 35 USC 102 as being anticipated by USP 6,350,609 (“Morozov et al”), and claims 16-18 were rejected

under 35 USC 103 as being obvious in view of Morozov et al. In addition, claims 1 and 16-18 were rejected under 35 USC 103 as being obvious in view of the combination of US 2005/0001868 ("Matsuba et al") and USP 6,120,122 ("Takemoto et al"). These rejections, however, are respectfully traversed with respect to the claims set forth above.

<u>Re: The Rejection Of Claim 1 In View Of Morozov et al</u>

Amended independent claim 1 recites a liquid ejection apparatus comprising: a liquid ejection head having a nozzle for ejecting a droplet of charged solution from a tip portion; an ejection electrode provided on the liquid ejection head, to which a voltage is applied for generating an electric field to eject the droplet; a voltage applying unit for applying the voltage to the ejection electrode<u>, wherein the voltage is less than a Rayleigh marginal voltage so that the ejected droplet is not scattered</u>; a substrate including insulative material for receiving ejected droplets; and an ejection atmosphere adjusting unit for <u>keeping an atmosphere in which the droplet is ejected from the liquid ejection head to a dew point of 9 degrees centigrade or more and less than a water saturation temperature</u>.

With this structure, it is possible to stably eject a droplet, and in particular even a minute droplet, so as not to scatter the ejected droplet by using the voltage that is less

than a Rayleigh marginal voltage. Accordingly, for example, it is possible to improve positional accuracy when drawing wiring patterns of a circuit using conductive ink with inkjet technology.

Morozov et al, by contrast, relates to an electrospray technique (see the abstract, for example). As explained at column 1, lines 23-43 of Morozov et al:

> The method of electrospray is the electrostatic atomization of a liquid or a solution to obtain charged microdroplets, charged clusters and ions. The solution or liquid of the substance to be deposited is placed into a capillary (or array of capillaries), and <u>the application of high voltage results in instability of the liquid or solution, which is then dispersed into small charged droplets 0.3-20 microns in diameter</u>, and typically about 0.5-2 microns in diameter. Electrostatic repulsion rapidly moves these charged microdroplets from the capillary tip, and in their travel toward a substrate surface, <u>the microdroplets evaporate if solvent vapor pressure is low enough, and the size of the droplets reach a Raleigh limit of electrostatic stability</u>. Afterwards, the microdroplets undergo a series of decays, reducing their size to about 10-20 nm and increasing the electrostatic field to a level where <u>evaporation</u> of ionized solvated molecules becomes possible. On further travel through a <u>dry gas</u>, solvent is lost from these solvated ionized molecules. <u>Where evaporation proceeds rapidly, all of the solute content of the microdroplets can be concentrated into small nanoclusters</u> (FIG. 1). (Emphasis added).

Thus, Morozov et al discloses electrospray, and does not disclose or suggest the features recited in amended independent claim 1.

Indeed, with respect to voltage, for example, Morozov et al discloses high voltages such as 5kV (example 1) or 7kV (example 2). In contrast, for example, the specification of the present application discloses an ejection voltage of 400V at page 53, lines 9-11.

It is respectfully submitted that Morozov et al does not disclose or suggest an apparatus comprising a voltage applying unit for applying the voltage to the ejection electrode, wherein the voltage is less than a Rayleigh marginal voltage so that the ejected droplet is not scattered, as recited in amended independent claim 1.

In addition, according to claim 1, the apparatus comprises an ejection atmosphere adjusting unit for keeping an atmosphere in which the droplet is ejected from the liquid ejection head to a dew point of 9 degrees centigrade or more and less than a water saturation temperature.

For example, as shown in Fig. 17 of the present application, when keeping the atmosphere in which the droplet is ejected from the liquid ejection head to a dew point of 9 degrees centigrade or more, humidity is more than 50% when the room temperature is 20°C, and humidity is more than 37% when the room temperature is 25°C.

By contrast, according to column 23, lines 35-37 (cited by the Examiner), Morozov et al discloses that "<u>[h]umidity is</u>

typically kept at about 10-30%. Besides the illustrated tank 500, dry air can be obtained with silica gel. Flow rates are typically 200-500 mL/min." Thus, Morozov et al discloses drying droplets to make a film.

In summary, with the structure recited in claim 1, an ejection atmosphere adjusting unit is provided for adjusting humidity. Accordingly, it is possible to stably eject a droplet, in particular even a minute droplet, so as not to scatter the ejected droplet using the voltage less than a Rayleigh marginal voltage. And it is respectfully submitted that Morozov et al is entirely different from the structure of claim 1.

Re: The Rejection Of Claim 1 In View Of Matsuba et al and Takemoto et al

Matsuba et al discloses "[a]n ink jet recording apparatus which performs printing by ink ejection, comprising: a pressure chamber in which ink liquid is filled; a nozzle hole [116] which is formed communicating with said pressure chamber; a piezoelectric element [113] which is formed on said pressure chamber, and deforms said pressure chamber by mechanical expansion and contraction, whereby pressure is generated in the pressure chamber, and ink is ejected from said nozzle hole; and a dew point control unit [123] which keeps a dew point in an atmosphere of said piezoelectric element and the vicinity of the

piezoelectric element at a lower value than a dew point in an environment where said ink jet recording apparatus is set." (Claim 1. Emphasis added.")

Takemoto et al discloses an electrostatic inkjet recording apparatus.

According to Matsuba et al, the dew point control unit 123 comprises a compressor 123a, and an air drier 123b which dries compression gas from the compressor 123a and feeds it to the piezoelectric element 113. (See, for example, paragraphs [0068] and [0069] of Matsuba et al.) Matsuba et al discloses keeping a dew point around the piezoelectric element low to prevent the element from breaking due to voltage application. (See, for example, paragraphs [0097] and [0100] of Matsuba et al.) Concretely, Matsuba discloses introducing gas of a low humidity (for example, dew point -60°C) so that a dew point in the case when the dry air has been introduced has been is -50°C. (See, for example, paragraphs [0069], [0078], and [0079] of Matsuba et al.)

By contrast, according to claim 1, the apparatus comprises an ejection atmosphere adjusting unit for keeping an atmosphere in which the droplet is ejected from the liquid ejection head to a dew point of 9 degrees centigrade or more and less than a water saturation temperature. The apparatus of claim 1 thus clearly

differs from the apparatus of Matsuba et al, even in view of Takemoto et al.

Re: The Rejections Of Claims 16-18

According to claim 16, which depends from claim 1, an inner diameter of the nozzle is more than 0.2 µm and not more than 20 µm. According to claim 17, which depends from claim 16, the inner diameter of the nozzle is not more than 8 µm. And according to claim 18, which depends from claim 17, the inner diameter of the nozzle is not more than 4 µm.

With this structure, the ejection start voltage becomes lower according as the nozzle diameter reduces, taking into account the field concentration effect with the use of a micro-diameter nozzle. Neither Matsuba nor Takemoto discloses such features of the present invention of claims 16-18.

As explained in the present application at page 34, lines 16-22, it has been found from the graph of FIG. 9 that, when the nozzle diameter is in the range from 0.2 to 4µm, the ratio of the ejection starting voltage to the Rayleigh marginal voltage is over 0.6, and a relatively large charge can be given to droplets even at low ejection voltage, resulting in good charging efficiency of droplets and stable ejection within the ran.

As explained at page 34, line 23 to page 35, line 7, FIGS. 10A and 10B, for example, are graphs showing the relationship between the nozzle diameter and a strong electric field area at the tip portion of the nozzle, the area being indicated by the distance from the center of the nozzle. The graphs of FIGS. 10A and 10B show that the area of electric field concentration becomes extremely narrow as the nozzle diameter becomes 0.2μm or less. This means that an ejected droplet cannot receive enough energy for acceleration and its flying stability is reduced. Therefore, it is preferable to set the nozzle diameter to be larger than 0.2μm.

Neither Matsuba et al nor Takemoto et al discloses such features. Indeed, it is respectfully submitted that Matsuba et al and Takemoto et al do not disclose or suggest that the nozzle diameter should be at least 0.2μm in the manner recited in claim 16.

Morozov et al also fails to disclose the features of the present invention as recited in claims 16-18.

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In view of the foregoing, it is respectfully submitted that amended independent claim 1 and claims 16-18 depending therefrom clearly patentably distinguish over Morozov et al, Matsuba et al,

and Takemoto et al, taken singly or in combination, under 35 USC 102 as well as under 35 USC 103.

Entry of this Amendment, allowance of the claims and the passing of this application to issue are respectfully solicited.

If the Examiner has any comments, questions, objections or recommendations, the Examiner is invited to telephone the undersigned at the telephone number given below for prompt action.

Respectfully submitted,

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